The uncomputable life and λ−Calculus: a case for the Philosophy of Computing

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Today's agenda

1 Introduction

- ▶ Introduction
- ▶ Self-referentiality, Combinators & Life
- ▶ Into the Philosophy of Computing for Theories of Life
- ▶ References

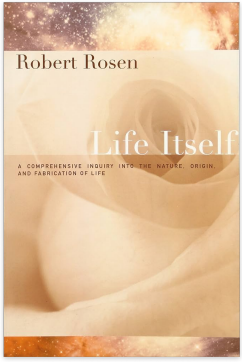
The question about life: Relational Biology

1 Introduction

Figura: Nicolas Rashevsky & Robert Rosen

Life Itself: Uncomputable

1 Introduction



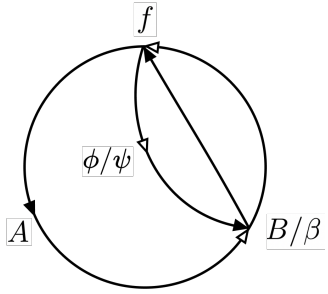


Figura: Robert Rosen's *Opus Magnum* & the $(M, R)-$System

Today's agenda

2 Self-referentiality, Combinators & Life

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Combinators

2 Self-referentiality, Combinators & Life

In Church's $\lambda-$Calculus, recursion can be achieved via fixed-point combinators. One of the most well-known combinators is known as the **Y-Combinator**:

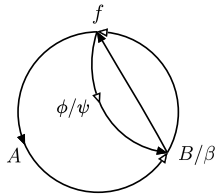
$$Y = (\lambda f.(\lambda x.f(x\ x))(\lambda x.f(x\ x)))$$

Y-Combinator

$$
\begin{aligned}
Y\,k &= (\lambda f.(\lambda x.f(x\,x))(\lambda x.f(x\,x)))k && (1)\\
&= (\lambda x.k(x\,x))(\lambda x.k(x\,x)) && (2)\\
&= k((\lambda x.k(x\,x))(\lambda x.k(x\,x))) && (3)\\
&= k(Y\,k) && (4)\\
&= k(k(Y\,k)) && (5)\\
&= \ldots && (6)
\end{aligned}
$$

This combinator can be used to simulate a `WHILE` loop when applied to functions of two or more parameters which are employed as counters.

Computability of life (?)



Categorical definitions
(Rosen, 1991)

$$f : A \mapsto B$$
$$\beta : f \mapsto \Phi$$
$$\psi : B \mapsto f$$

Combinator approximation
(Mossio et al., 2009)

$$(f\,A) = B$$
$$(\Phi\,B) = f$$
$$(B\,f) = \Phi$$

Cárdenas et al. (2010) showed that Mossio et al. may have misidentified

$$B/\beta$$

as representing

$$B = \beta.$$

In this case, identification is not equality. Without this equality, a fixed-point closure cannot be built within the specification.

Towards a canonical form for (M,R)

Rosen never produced a Computational-theoretic proof, *quae est quaerenda*. Rosen's work, if correct, would render Artificial Life *in silico* impossible and, when taking into account the Life-Mind Continuum hypothesis (Kirchhoff & Froese, 2017), Rosen's argument could render Artificial Intelligence unattainable as well.

These profound potential results can foster discussions within the nascent field of Philosophy of Computing which could, in turn, lead us to the canonical form of (M, R).

Other theories of life lead to the hypercomputational:

- **Artficial Living Systems:** It has been argued that, when placed in communities, ALS themselves give rise to super-Turing capabilities (Cárdenas-García, 2023)
- **Informational-Autopoietic Systems:** Only self-referential, recursive and interactive system of self-production of information can be sentient. (Wiedermann & van Leeuwen, 2001).
- **Irruption-enabled Systems:** Irruption is only possible on hypermachines, whilst classical machines are merely Absorption-enabled (Soto-Astorga & Froese, 2024).

Why hypercomputing

2 Self-referentiality, Combinators & Life

If Rosen's argument is correct, and if one were to insist on the machine metaphor to explain life, classical computing machinery will not suffice. *Ergo*, some other specification which can capture self-referentiality and impredicativity is required.

Today's agenda

3 Into the Philosophy of Computing for Theories of Life

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Some hints leading us into the Philosohpy of Computing

- Uncomputability as orchestration: (M) and (R), as separate subsystems, are computable. Orchestration under efficient closure makes them part of an uncomputable expression of life.
- **ALS and orchestration:** the same orchestration of *cognitive automata* uses a similar approach.
- **Rosen's notion of simulation:** Rosen left this world owing us a computational proof of his *dictum*, yet his notion of simulation is worth exploring.
- **The CTT:** The apparent violation of the Church-Turing Thesis is of interest, too.

Alternatives in the Philosophy of Computing

3 Into the Philosophy of Computing for Theories of Life

Philosophy of Computing, in its general form, allows us to ask ample questions regarding subjects of interests. Injecting Rosen's research into the framework of General Philosophy of Computing might allow us to find alternatives to purely formalistic attempts of explanation:

1. Find a computationally-canonical form for (M, R) based on Sieg's Axioms for Computability.
2. Japaridze argues that Turing's and Church's notion of algorithm is outdate and a new one, which includes interactivity, should be found.
3. Luis Pineda's pluralist definition of computing allows for hypercomputation to exist without violating the CTT.
4. Studying fixed-point combinators as supertasks.

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Thank you!

Any questions?